THE LIFE HISTORY OF SERICA SERICEA (ILL.) (SCARABÆIDÆ–COLEOPTERA)*

By Clarence H. Hoffmann
University of Minnesota, St. Paul, Minnesota

Although the genus *Serica* MacL. has received considerable attention taxonomically, little has been written concerning the biology of members of this genus. Grubs of certain species of this genus may be of considerable economic importance inasmuch as they have been found associated with *Phyllophaga* grubs attacking the roots of coniferous seedlings in northern Minnesota. The adults, on the other hand, cause damage by defoliating many kinds of plants.

I am indebted to Dr. C. E. Mickel for calling my attention to an outbreak of *S. sericea* in Anoka County, Minnesota, to Dr. R. W. Dawson for making determinations within the genus *Serica*, and to both of these gentlemen for aid in making some of the collections during the three years this study was in progress.

Habitat. The site of the *S. sericea* infestation studied was an upland, burned-over area in Anoka County, near Anoka, Minnesota. Previous to the time it was cleared and burned over to provide better pasturing facilities, this area was a deciduous woods. It is flanked by Coon Creek on one side and what was once the Mississippi River bed on the other. The vegetation of this area consisted chiefly of a rank sucker growth arising from cut oak stumps, many grasses, and an abundance of hazel shrubs well embedded in the sandy soil.

On the night of May 12, 1932, the three of us collected approximately 600 adults of this species between the hours of seven and nine o'clock. Most of the beetles were feeding on the newly emerged oak leaves which were arising from sucker growth, the shoots of which seldom exceeded two feet in length. Defoliation was severe on much of this secondary growth, but slight on the large oak trees adjoining the burned-over area. Although the

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beetles seemed to prefer oak leaves, they feed extensively on the leaves of nearby hazel shrubs.

About a year later, May 16, 1933, Dr. Dawson and I in one and one-half hours' time captured 475 adults feeding on oak and hazel leaves. As many as 66 individuals of *S. sericea* were collected from the shoots encircling a single oak stump. Larvæ of this species were found associated with the roots of hazel and oak, especially with hazel roots. One small hazel shrub uprooted on September 15, 1932, yielded 10 larvæ, all of which were within the upper three inches of soil among the anastomosing roots.

HIBERNATION. This species overwinters in three different stages, namely, as a first-year grub, as a second-year grub, and as an adult. Diggings made September 19, 1933, revealed first and second-year grubs, as well as recently emerged adults, in the upper 17 inches of soil surrounding hazel roots. The larvæ in the upper 8 inches of soil were quite active, whereas those at greater depths were inactive. Seven adults, three males and four females, were taken at a depth of 14 inches. All of the adults were inactive. Diggings made two months later likewise yielded all three stages of this scarabæid; the grubs having migrated to a maximum depth of 24 inches in the soil.

MATING AND PREOVIPOSITION PERIOD. Overwintering adults issue forth during the early part of May coincident with the appearance of spring foliage, and mating soon follows. Eleven pairs of adults were taken *in copula* on oak and hazel leaves in Anoka County, Minnesota on the night of May 12, 1932. Observations in the field and in the laboratory show that the beetles mate for at least an hour, and that mating may take place during all hours of the night. In the laboratory, where a temperature of about 23° C., was maintained the females were confined in salve boxes containing soil. Under these conditions, the average duration of the preoviposition period for 12 females was 19 days, with extremes of 16 and 20 days.

OVIPOSITION AND FECUNDITY. Mated females readily oviposited when isolated in four-ounce salve boxes, or in flower pots, both of which were supplied with moist soil. The length of the oviposition period varied from one to four weeks, most of the eggs being laid during early June. Unlike most members of the

family Scarabæidæ, this species usually deposits its eggs in a mass instead of singly. The eggs are laid several inches below the surface of the soil, and, since the soil adheres to the mass, the mass may be easily passed by as a small clod of earth. Fecundity records kept for 17 females gave an average of 38 eggs for each female (minimum, 28 eggs; maximum, 47 eggs). Only a few adults had a longevity exceeding one month.

EGG STAGE. The eggs, when freshly deposited, are pearly-gray in color and elongate-oval in shape. The measurements of a small series were found to average 1.1 mm. in length and .88 mm. in width. As development proceeds, the eggs become chalky white, minutely alutaceous, and assume a more spherical form. Six eggs measured shortly before hatching averaged 1.4 mm. in length and 1.1 mm. in width. Eggs obtained from oviposition cages were isolated within moist black soil in two-ounce salve boxes throughout the oviposition period. These salve boxes were kept at about 32° C., and the length of the egg stage was found to vary from 4 to 16 days, with a mean of 6.8 days for 121 eggs kept under observation. Repeated observations showed that eggs isolated in quite moist soil hatched sooner than those kept in drier soil.

Before hatching the darkened mandibles may be seen clearly through the chorion of the egg. The rupturing of the egg-shell occurs across the back in the region of the thorax and first abdominal segments, and appears to be accomplished by body contractions of the embryo. Following the first small rupture in the egg shell, one grub required only 4 minutes to extricate itself from the shell, but more time was needed to complete the process of hatching by most of the grubs observed. A few hours following hatching the grubs deserted the egg-shell and began to feed on soil.

LARVAL STAGE. A large number of small grubs as well as two-year grubs were isolated for rearing in containers supplied with germinating corn, germinating wheat, a combination of vegetable mold and black soil, and grass sod, but all succumbed within a month or two. Instead of attempting to rear the grubs on hazel and oak roots in the laboratory, the writer decided to study the species under field conditions in Anoka County, so periodic dig-

gings were made at the site already described under habitat. As already indicated under hibernation, these diggings show clearly that *S. sericea* has a three-year life cycle.

DESCRIPTION OF LARVA. Mature *Serica sericea* grubs measure approximately 13 mm. in length and 4 mm. in width. The head capsule is largely light brown in color, 1.8 mm. in length and 1.5 mm. at its greatest width; epicranial suture and epicranial arms present but rather indistinct; setation sparse; antennæ five-segmented, third segment almost as long as four and five together; clypeus rectangular, three times as wide as long, sparsely setose; labrum broadly ovate with two anterior emarginations producing a small prominent median lobe, strongly setose on anterior margin.

Apical half of mandibles dark brown or black, scissorial area minutely denticulate; maxillary palpus three-segmented; distal end of galea and lacinia setose; lateral lobes of epipharynx with lateral striæ, setæ on lateral margin increase in length and density distally, three prominent spines in distal sensory area, small setæ present throughout epipharynx except for small area in disk.

Thorax and abdomen white, long brown setæ sparse except on dorsum of tenth abdominal segment, dense; dorsum of first six abdominal segments densely covered with short erect setæ; anal slit obtuse; radula with a conspicuous transverse row of closely set spines, scattered short spines on both sides of mid-line.

Newly hatched grubs of this species are not unlike mature grubs except for their smaller size.

PUPAL STAGE. Although diggings were made periodically for three years in the infested area, living pupæ were not taken. The fact that the first newly emerged adult taken in diggings was on August 30, and, inasmuch as dead pupæ and old pupal casts were taken in diggings made the 12th and 18th of September, it is likely that this species pupates the later half of August. Most of the dead pupæ and old pupal casts were taken at a depth of 12 inches in the soil.

FOOD HABITS AND BEHAVIOR OF ADULT. These crepuscular insects seldom came out for feeding before 8:30 o'clock in the evening. During the daytime they hide beneath the bark of

trees, underneath debris accumulated below shrubs and trees, or in temporary cells within the upper two inches of soil. Adults of *S. sericea* have been taken while feeding on the leaves of oak, hazel, wild plum, aspen, birch, ash, and willow. In the laboratory, the leaves of lilac and box elder were readily consumed by captive beetles. When disturbed the beetles feign death. Advantage of this habit was taken while collecting the beetles. By shaking the limbs of small trees or shrubs into an opened umbrella, large numbers could be collected in a short time.

NOTES ON OTHER SCARABÆIDÆ CAPTURED WITH S. SERICEA. While collecting large numbers of *S. sericea* on the night of May 16, 1933, a good series of *Phyllophaga drakei* Kby., and a few specimens of *Phyllophaga anxia* Lec. were captured while feeding on oak and hazel leaves. One night early in that month large numbers of *Phyllophaga tristis* (Fab.) were seen feeding on the leaves of a large oak tree. On the night of May 8, 1934, about 40 adults of the rather uncommon *Phyllophaga prunina* Lec. were taken feeding on oak leaves.

Several species of *Serica* were often found associated with *sericea,* but their numbers were always comparatively small. On May 14, 1932, approximately 30 adults of *S. intermixta* Blatch. were captured while feeding on the leaves of oak, wild plum, birch, and willow. Two adults of this same species were taken on oak and hazel leaves on the night of May 16, 1933, along with 6 adults of *S. atracapilla* (Kby.), and 20 adults of *S. parallela* Csy.